MECHATRONICS BOOK SERIES SYSTEM DESIGN AND SIGNAL PROCESSING

VOLUME 1

Editors
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Siti Fauziah Toha
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IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

ISBN: 978-967-418-173-4

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan
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CONTENTS

CHAPTER 20

Development of Unmanned Aerial Vehicle : Part 2

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20.1 Introduction

Today, the unmanned aerial vehicle (UAV) has been found very useful in many applications, from defence, down to agricultural sector. However, the UAV is usually very expensive and not accessible for public. This chapter describes a UAV designed to accomplish specific objectives at a lower cost to make it affordable for personal use for research and farming purposes. The UAV is able to fly based on the command signal to the designated location coordinate and able to report back to ground station its current position; longitude and latitude as well as altitude from the embedded GPS unit. In addition, the UAV has the ability to capture video through wireless camera and send the image data to the ground station for real time streaming. It could communicate the information to the ground control for analysis. The description and the design of the UAV are presented in Chapter 19. The calculation of force acting on the UAV is also presented in the chapter to justify the design and the selection of components to construct the UAV.

20.2 Inite Element Analysis (FEA) Simulation On Critical Structure

Having the design of the UAV, it is concerned that some parts of the aircraft might not be able to withstand the forces applied on it. Considering the material selection to build the UAV is based on depron or expanded polystyrene. The main concern falls into the wing structure of the aircraft. This is mainly because the material used in the system is based on expanded polystyrene Styrofoam (EPS) or so called depron.

20.2.1 Wingspan without Strengthening Structure. The total area of the wing structure as per CAD design is 0.233 m^2 with the wingspan of 1.3 m apart, the depron might not be strong enough to withstand the load it has to carry. The FEA is done by using the Generative Structural Analysis environment in CATIA V5. From part design, the wing is transferred to the FEA environment and first and foremost, material of the structure has to be defined. According to [2,3] the Young's Modulus of depron is 1.6 x 109 N/m2, the Poisson's Ratio is 0.30, and the density is 8 kg/m3, and the yield strength of the material is 7.5 x 104 N/m2. After the wing material has been defined, it is time to set the constraint. The centre of the wing is the fuselage of the aircraft. Thus, the area which holds the fuselage is assumed to be fixed. Therefore the clamp function is applied to fix the area as per Fig. 20.1. For easier calculation, the fuselage area that covers the wing is taken to be a 64mm x 200mm rectangular at the center of the wing.

The wing will have to withstand the total load of the UAV. In the calculation of balanced aerodynamic forces, the total weight of the aircraft is taken to be 2 kg. We will take the same mass so that the load that the wing has to bear is 20 N by taking gravitational acceleration, g = 10 m/s^2 for easy calculation. The force will be carried by both sides of the wings so the distributed force is 10 N facing downwards normal to the face of the wing. According to the software analysis, the maximum stress was pointed out to be 4.4 x 105 N/m^2 at the point where the wing and fuselage are connected. The maximum deformation of the depron was 0.287 m at the tip of the wing.